

Enhanced Delta Smelt Monitoring

2020 Phase 3 Sampling

Preliminary Analysis

DRAFT

U.S. Fish and Wildlife Service

November 30, 2020

Overview

On June 29, 2020, the Enhanced Delta Smelt Monitoring (EDSM) program started 2020 Phase 3 sampling program for juvenile and sub-adult Delta Smelt. In order to improve our ability to make inferences about the population, sampling effort is being focused on eight geographic areas where Delta Smelt are likely to be caught based on historical data. Sampling locations are generated using a generalized random-tessellation stratified (GRTS) design [Stevens and Olsen, 2004] with stratification and equal probability sampling. Trawling gear similar to that used in the California Department of Fish and Wildlife's [Spring Kodiak Trawl Survey](#) is used to conduct multiple tows per location.

Everything presented here is preliminary and subject to correction, revision, and improvement. The following points should be taken into consideration when interpreting the results:

1. Delta Smelt captured outside of the live box or cod end of the net could not be assigned to a specific tow and were excluded from this analysis. These fish are included in the daily catch summary and are indicated by a Gear Condition Code of 9. Delta Smelt captured in highly impaired samples, e.g., samples with large net blockages of debris or vegetation, were also excluded from this analysis. These fish are included in the daily catch summary and are indicated by a Gear Condition Code of 3.
2. The **Week** designations used here were defined out of convenience and are subject to change.
3. Current sampling is limited to areas of the Bay-Delta that can be safely navigated by EDSM vessels, which means areas with a minimum depth of approximately 8 feet. The abundance estimation method used here assumes that the density of fish in unsampled areas (i.e., those with depth less than 8 feet) is the same as in sampled areas (i.e., those with depth greater than or equal to 8 feet).
4. The methods of analysis used here remain in development.

Change Log

Report date August 7, 2020:

- Three fish caught in the Sacramento Deep Water Shipping Channel during Week 2 (July 6 – 10) were originally identified in the field as Wakasagis but have now been identified in the lab as Delta Smelt. This caused the abundance estimate for Week 2 to increase.

Report date August 21, 2020:

- Sampling was cut short the week of August 17, 2020 because of poor air quality resulting from fires.

Report date August 31, 2020:

- Sampling was limited because of poor air quality resulting from fires.

Report date September 14, 2020:

- Sampling was limited because of poor air quality resulting from fires.

Report date October 2, 2020:

- Sampling was limited because of poor air quality resulting from fires.

Results

Table 1: Delta Smelt catch summary and abundance estimates by week. An asterisk (*) is used to emphasize weeks when no Delta Smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters.

	Stratum	Number of Sites	Number of Tows	Number Caught	Total Sample Volume	Estimate and 95% CI		
						Abundance	Lower Bound	Upper Bound
Week 1: June 29 - July 2, 2020								
	Suisun Bay	6	22	2	92,860	14,598	1,578	57,989
	Suisun Marsh	6	24	0	97,007	0*	-	-
	Lower Sacramento	6	24	0	101,146	0*	-	-
	Cache Slough LI	6	24	0	83,627	0*	-	-
	Sac DW Ship Channel	7	26	1	86,511	488	65	1,788
	Lower San Joaquin	6	24	0	117,102	0*	-	-
	Total	37	144	3	578,255	15,086	1,727	58,676
Week 2: July 6 - 10, 2020								
	Suisun Bay	6	24	0	115,756	0*	-	-
	Suisun Marsh	6	24	0	108,651	0*	-	-
	Lower Sacramento	6	24	4	97,866	9,539	2,387	26,231
	Cache Slough LI	6	24	0	92,034	0*	-	-
	Sac DW Ship Channel	6	21	6	88,958	3,353	842	9,202
	Lower San Joaquin	6	24	0	95,297	0*	-	-
	Total	36	141	10	598,562	12,893	4,314	30,131
Week 3: July 13 - 16, 2020								
	Suisun Bay	6	24	0	108,845	0*	-	-
	Suisun Marsh	6	24	0	103,902	0*	-	-
	Lower Sacramento	6	24	0	90,377	0*	-	-
	Cache Slough LI	6	23	0	90,456	0*	-	-
	Sac DW Ship Channel	6	23	1	97,534	432	60	1,561
	Lower San Joaquin	6	24	0	91,046	0*	-	-
	Total	36	142	1	582,160	432	60	1,561
Week 4: July 20 - 24, 2020								
	Suisun Bay	6	24	0	124,411	0*	-	-
	Suisun Marsh	6	22	1	100,833	1,048	144	3,795
	Lower Sacramento	6	24	0	96,341	0*	-	-
	Cache Slough LI	6	22	0	76,300	0*	-	-
	Sac DW Ship Channel	6	24	0	101,761	0*	-	-
	Lower San Joaquin	3	12	0	48,999	0*	-	-

Table 1: Delta Smelt catch summary and abundance estimates by week. An asterisk (*) is used to emphasize weeks when no Delta Smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters.

Stratum	Number of Sites	Number of Tows	Number Caught	Total Sample Volume	Estimate and 95% CI		
					Abundance	Lower Bound	Upper Bound
Total	33	128	1	548,645	1,048	144	3,795
Week 5: July 27 - 30, 2020							
Suisun Bay	6	22	0	104,923	0*	-	-
Suisun Marsh	6	24	0	105,820	0*	-	-
Lower Sacramento	6	24	0	96,728	0*	-	-
Cache Slough LI	6	24	0	90,840	0*	-	-
Sac DW Ship Channel	6	24	0	83,993	0*	-	-
Lower San Joaquin	6	22	0	79,692	0*	-	-
Total	36	140	0	561,997	0*	-	-
Week 6: August 3 - 6, 2020							
Suisun Bay	6	22	0	116,664	0*	-	-
Suisun Marsh	6	24	0	100,352	0*	-	-
Lower Sacramento	6	24	1	107,153	1,143	158	4,127
Cache Slough LI	6	24	0	77,112	0*	-	-
Sac DW Ship Channel	6	24	1	86,226	488	67	1,766
Lower San Joaquin	6	24	0	91,909	0*	-	-
Total	36	142	2	579,416	1,631	345	4,882
Week 7: August 10 - 13, 2020							
Suisun Bay	6	24	0	99,176	0*	-	-
Suisun Marsh	6	22	1	92,716	1,873	99	9,268
Lower Sacramento	6	24	0	101,183	0*	-	-
Cache Slough LI	6	24	0	88,740	0*	-	-
Sac DW Ship Channel	6	22	2	76,113	1,106	259	3,148
Lower San Joaquin	6	24	0	95,702	0*	-	-
Total	36	140	3	553,629	2,979	356	11,399
Week 8: August 17 - 19, 2020							
Suisun Bay	6	24	0	116,796	0*	-	-
Suisun Marsh	0	-	-	-	-	-	-
Lower Sacramento	1	2	0	8,950	0*	-	-
Cache Slough LI	6	24	0	90,815	0*	-	-
Sac DW Ship Channel	0	-	-	-	-	-	-
Lower San Joaquin	6	24	0	96,747	0*	-	-
Total	19	74	0	313,308	-	-	-
Week 9: August 27 - 28, 2020							
Suisun Bay	1	4	0	17,699	0*	-	-
Suisun Marsh	3	12	0	50,596	0*	-	-
Lower Sacramento	0	-	-	-	-	-	-
Cache Slough LI	3	12	0	41,707	0*	-	-
Sac DW Ship Channel	3	12	0	44,978	0*	-	-

Table 1: Delta Smelt catch summary and abundance estimates by week. An asterisk (*) is used to emphasize weeks when no Delta Smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters.

Stratum	Number of Sites	Number of Tows	Number Caught	Total Sample Volume	Estimate and 95% CI		
					Abundance	Lower Bound	Upper Bound
Lower San Joaquin	3	12	0	45,132	0*	-	-
Total	13	52	0	200,113	-	-	-
Week 10: August 31 - September 3, 2020							
Suisun Bay	6	22	0	106,383	0*	-	-
Suisun Marsh	6	24	0	100,017	0*	-	-
Lower Sacramento	6	24	0	99,565	0*	-	-
Cache Slough LI	6	24	0	86,445	0*	-	-
Sac DW Ship Channel	6	24	0	88,510	0*	-	-
Lower San Joaquin	6	24	0	88,788	0*	-	-
Total	36	142	0	569,707	0*	-	-
Week 11: September 8 - 10, 2020							
Suisun Bay	1	4	0	17,185	0*	-	-
Suisun Marsh	0	-	-	-	-	-	-
Lower Sacramento	0	-	-	-	-	-	-
Cache Slough LI	0	-	-	-	-	-	-
Sac DW Ship Channel	1	4	0	15,992	0*	-	-
Lower San Joaquin	0	-	-	-	-	-	-
Total	2	8	0	33,177	-	-	-
Week 12: September 14 - 18, 2020							
Suisun Bay	5	20	0	93,360	0*	-	-
Suisun Marsh	4	16	0	66,451	0*	-	-
Lower Sacramento	6	24	0	107,218	0*	-	-
Cache Slough LI	3	12	0	44,963	0*	-	-
Sac DW Ship Channel	6	24	0	84,465	0*	-	-
Lower San Joaquin	4	16	0	59,583	0*	-	-
Total	28	112	0	456,039	0*	-	-
Week 13: September 21 - 24, 2020							
Suisun Bay	6	24	0	99,418	0*	-	-
Suisun Marsh	6	24	1	95,302	2,490	174	11,414
Lower Sacramento	6	24	0	91,541	0*	-	-
Cache Slough LI	6	24	0	103,452	0*	-	-
Sac DW Ship Channel	6	24	0	105,964	0*	-	-
Lower San Joaquin	6	24	0	88,895	0*	-	-
Total	36	144	1	584,572	2,490	174	11,414
Week 14: September 28 - 30, 2020							
Suisun Bay	6	24	0	101,027	0*	-	-
Suisun Marsh	0	-	-	-	-	-	-
Lower Sacramento	3	11	0	42,241	0*	-	-
Cache Slough LI	3	10	0	37,481	0*	-	-

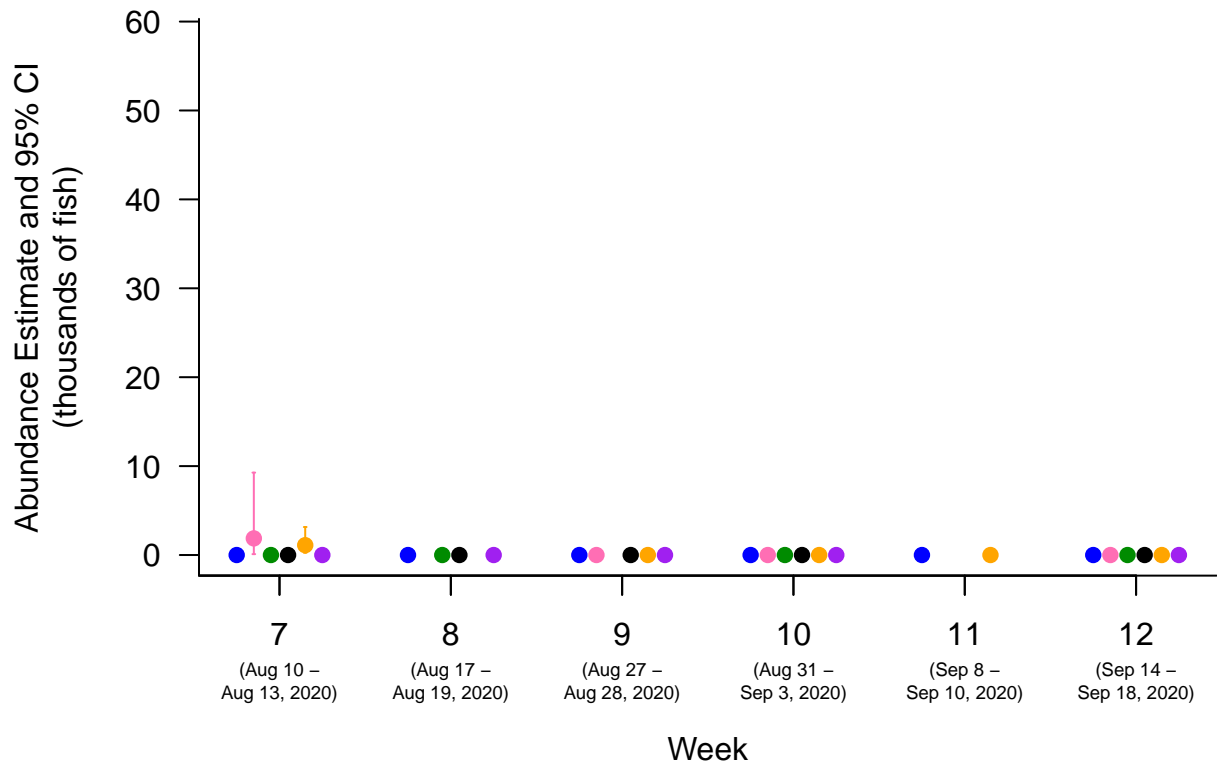
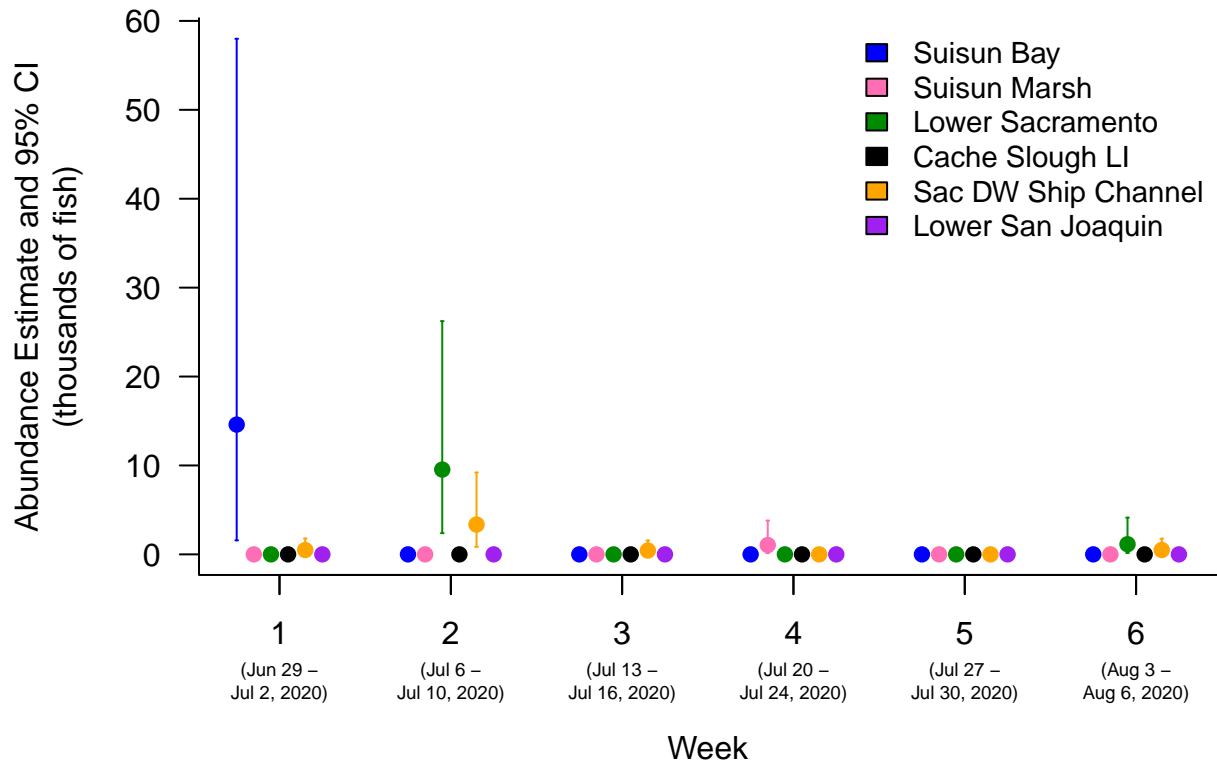
Table 1: Delta Smelt catch summary and abundance estimates by week. An asterisk (*) is used to emphasize weeks when no Delta Smelt were caught and a dash (-) is used to indicate that sampling did not occur or that a quantity could not be calculated. In order to avoid confusion, weekly totals are only calculated when sampling has occurred in every stratum. Sample volumes are in cubic meters.

Stratum	Number of Sites	Number of Tows	Number Caught	Total Sample Volume	Estimate and 95% CI		
					Abundance	Lower Bound	Upper Bound
Sac DW Ship Channel	6	23	0	87,706	0*	-	-
Lower San Joaquin	0	-	-	-	-	-	-
Total	18	68	0	268,455	-	-	-
Week 15: October 5 - 8, 2020							
Suisun Bay	6	23	0	102,407	0*	-	-
Suisun Marsh	7	23	0	93,633	0*	-	-
Lower Sacramento	6	23	0	102,508	0*	-	-
Cache Slough LI	6	24	0	83,590	0*	-	-
Sac DW Ship Channel	6	22	0	90,803	0*	-	-
Lower San Joaquin	6	22	0	81,618	0*	-	-
Total	37	137	0	554,559	0*	-	-
Week 16: October 13 - 16, 2020							
Suisun Bay	6	24	0	96,015	0*	-	-
Suisun Marsh	6	24	0	85,945	0*	-	-
Lower Sacramento	6	24	0	104,258	0*	-	-
Cache Slough LI	6	24	0	91,189	0*	-	-
Sac DW Ship Channel	6	24	0	100,475	0*	-	-
Lower San Joaquin	6	24	0	103,321	0*	-	-
Total	36	144	0	581,203	0*	-	-
Week 17: October 19 - 22, 2020							
Suisun Bay	6	24	0	104,851	0*	-	-
Suisun Marsh	6	24	0	96,644	0*	-	-
Lower Sacramento	6	24	0	113,768	0*	-	-
Cache Slough LI	7	23	0	90,049	0*	-	-
Sac DW Ship Channel	6	24	0	98,547	0*	-	-
Lower San Joaquin	6	24	0	93,586	0*	-	-
Total	37	143	0	597,444	0*	-	-
Week 18: October 27 - 30, 2020							
Suisun Bay	6	24	0	98,419	0*	-	-
Suisun Marsh	6	24	0	101,222	0*	-	-
Lower Sacramento	6	24	0	104,285	0*	-	-
Cache Slough LI	6	24	0	78,378	0*	-	-
Sac DW Ship Channel	6	24	0	88,027	0*	-	-
Lower San Joaquin	6	24	0	98,325	0*	-	-
Total	36	144	0	568,655	0*	-	-
Week 19: November 2 - 6, 2020							
Suisun Bay	6	24	0	102,478	0*	-	-
Suisun Marsh	6	24	0	88,011	0*	-	-
Lower Sacramento	6	24	0	93,605	0*	-	-

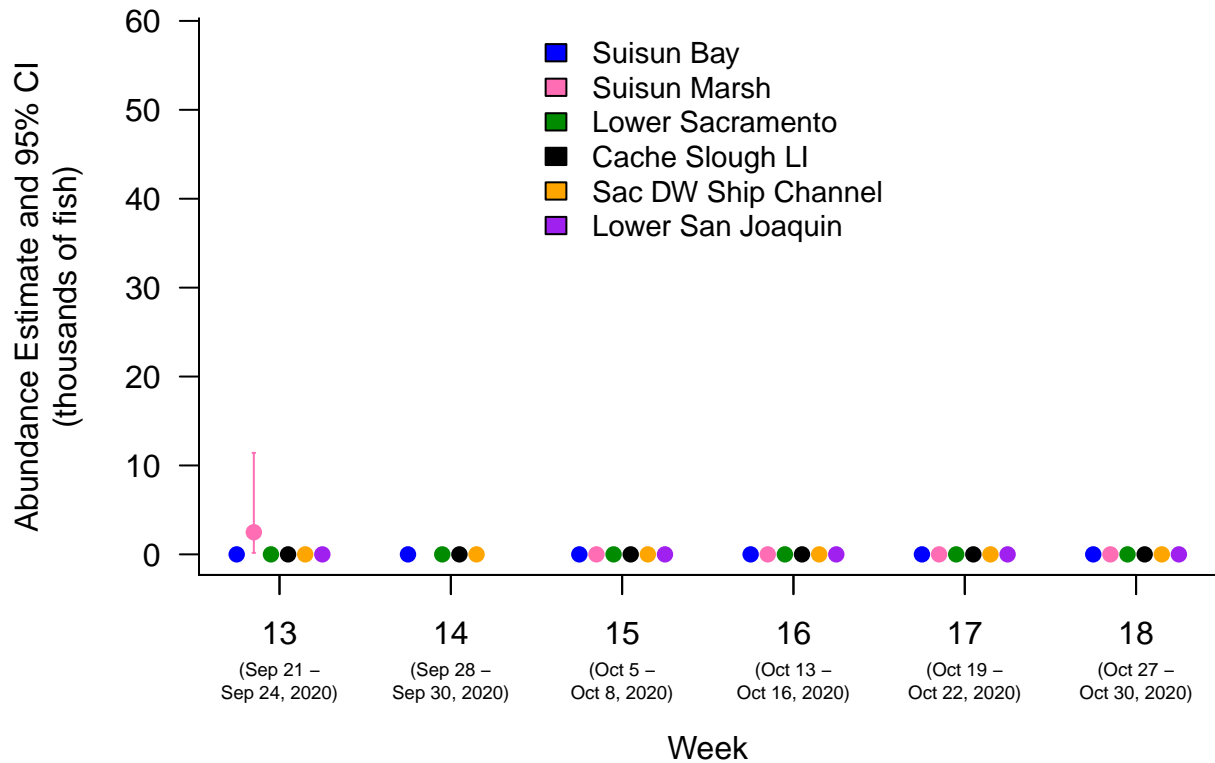
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Stratum	Number of Sites	Number of Tows	Number Caught	Total Sample Volume	Estimate and 95% CI		
					Abundance	Lower Bound	Upper Bound
Cache Slough LI	6	24	0	83,448	0*	-	-
Sac DW Ship Channel	6	24	0	90,680	0*	-	-
Lower San Joaquin	6	24	0	100,788	0*	-	-
Total	36	144	0	559,010	0*	-	-
Week 20: November 9 - 13, 2020							
Suisun Bay	6	24	0	112,636	0*	-	-
Suisun Marsh	6	22	1	84,571	1,249	173	4,516
Lower Sacramento	6	24	0	96,721	0*	-	-
Cache Slough LI	6	24	0	87,041	0*	-	-
Sac DW Ship Channel	6	24	0	93,589	0*	-	-
Lower San Joaquin	6	24	0	95,404	0*	-	-
Total	36	142	1	569,963	1,249	173	4,516
Week 21: November 16 - 19, 2020							
Suisun Bay	6	24	0	108,978	0*	-	-
Suisun Marsh	6	24	0	111,714	0*	-	-
Lower Sacramento	6	24	0	91,521	0*	-	-
Cache Slough LI	6	24	0	90,781	0*	-	-
Sac DW Ship Channel	6	24	0	89,519	0*	-	-
Lower San Joaquin	6	24	0	87,369	0*	-	-
Total	36	144	0	579,881	0*	-	-
Week 22: November 23 - 27, 2020							
Suisun Bay	6	23	0	99,280	0*	-	-
Suisun Marsh	5	20	0	77,073	0*	-	-
Lower Sacramento	6	24	0	96,142	0*	-	-
Cache Slough LI	6	24	0	88,451	0*	-	-
Sac DW Ship Channel	6	24	0	93,395	0*	-	-
Lower San Joaquin	6	24	0	97,244	0*	-	-
Total	35	139	0	551,586	0*	-	-

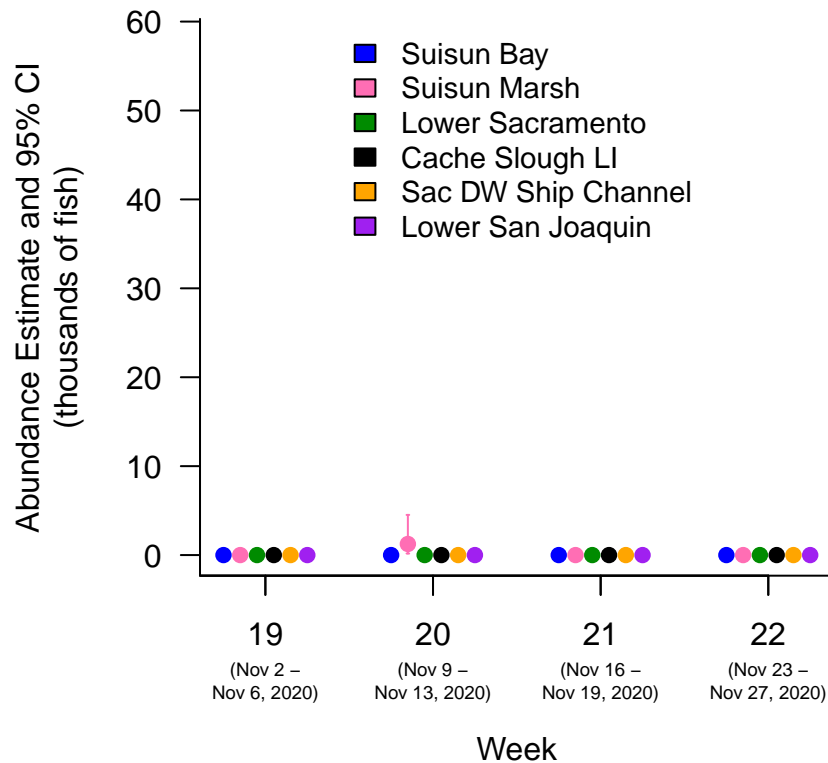
Delta Smelt Abundance Estimates Over Time



Delta Smelt Abundance Estimates Over Time



Delta Smelt Abundance Estimates Over Time



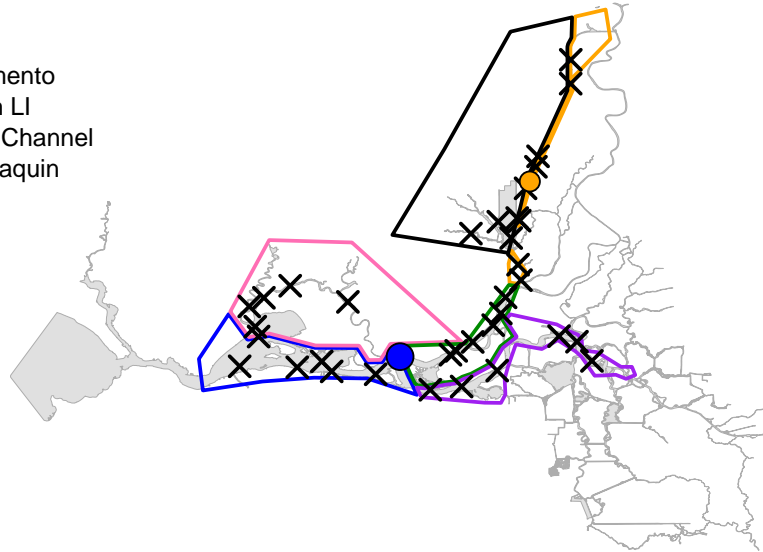
Week 1 (June 29 – July 2, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

- × 0
- 1
- 2



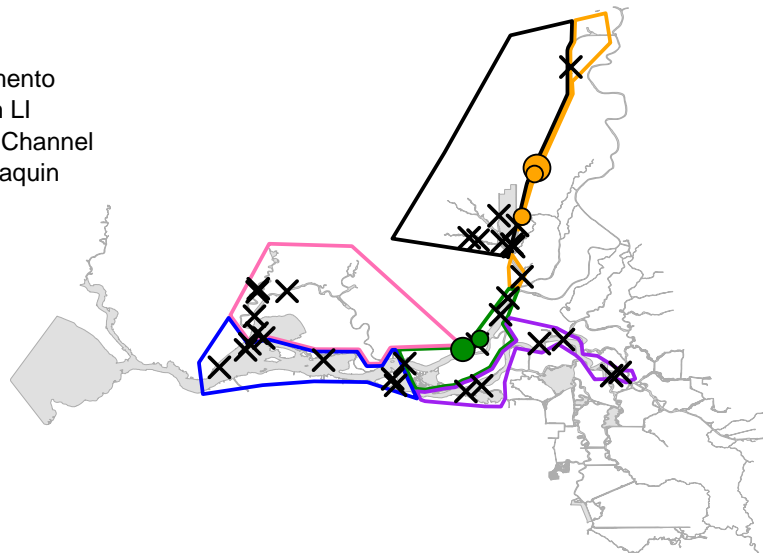
Week 2 (July 6 – 10, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

- × 0
- 1
- 2
- 4



Week 3 (July 13 – 16, 2020)

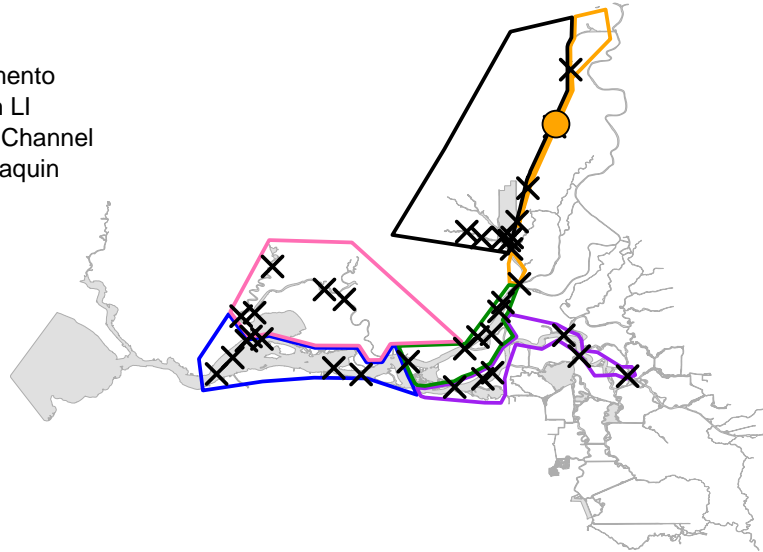
Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

× 0

● 1



Week 4 (July 20 – 24, 2020)

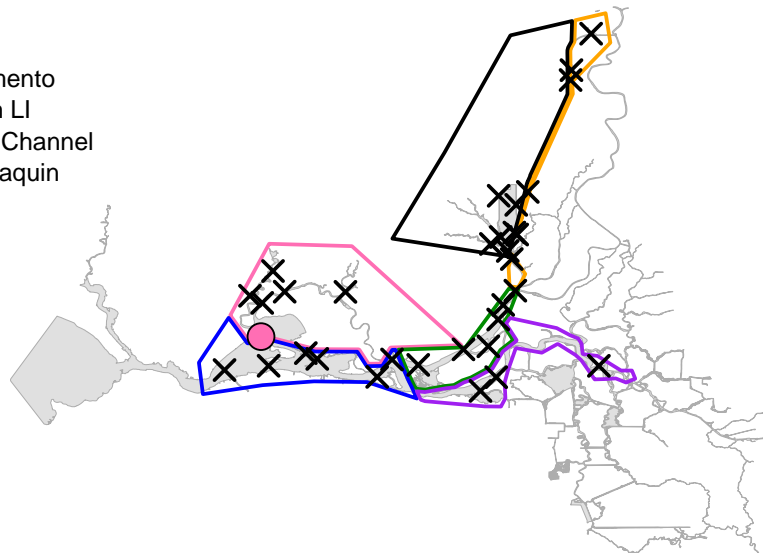
Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

× 0

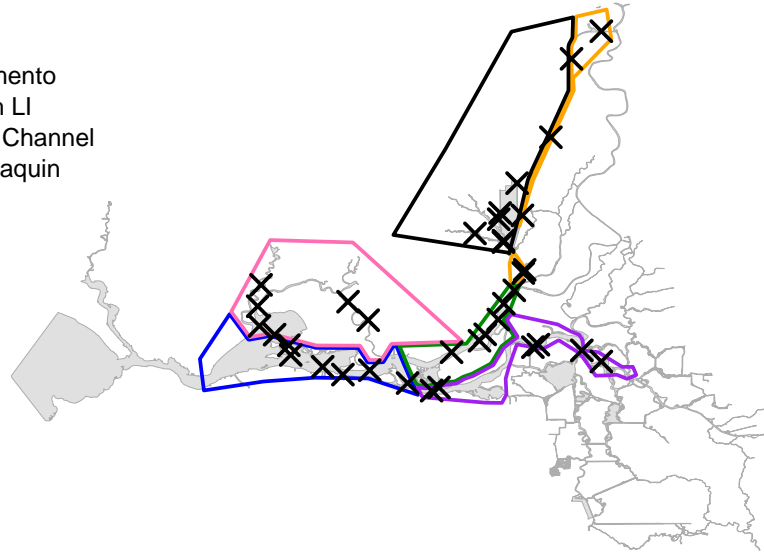
● 1



Week 5 (July 27 – 30, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



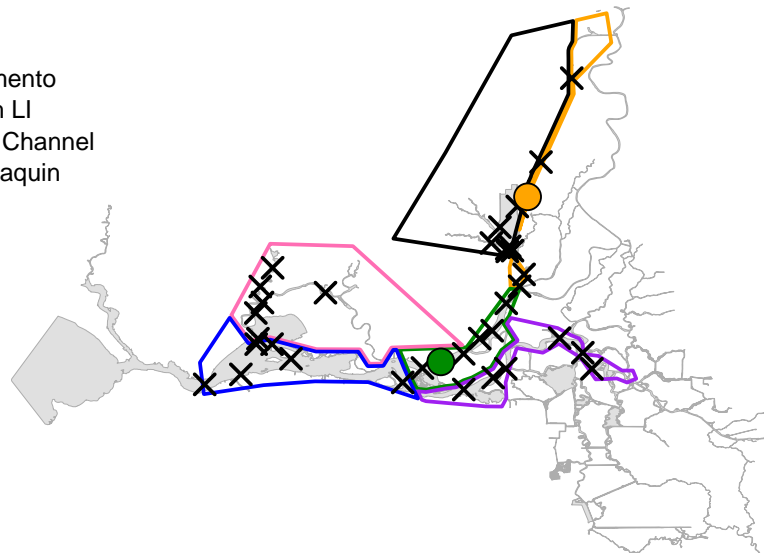
Total Catch

X 0

Week 6 (August 3 – 6, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



Total Catch

X 0

● 1

Week 7 (August 10 – 13, 2020)

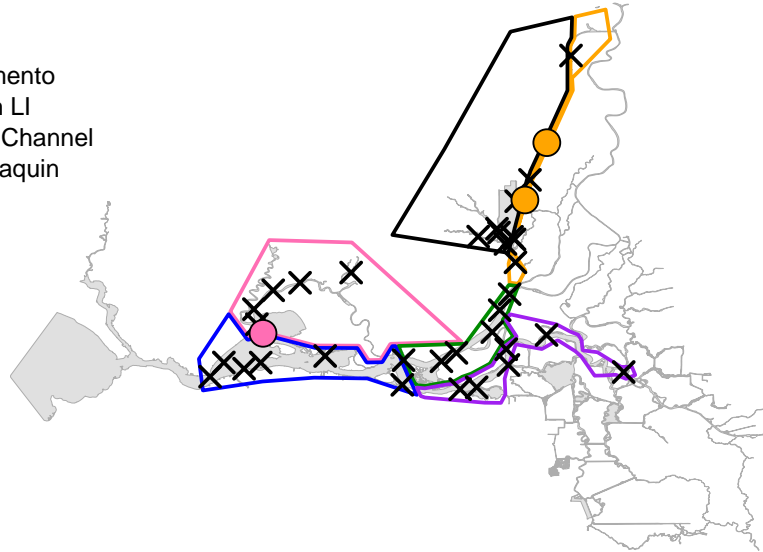
Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

× 0

● 1



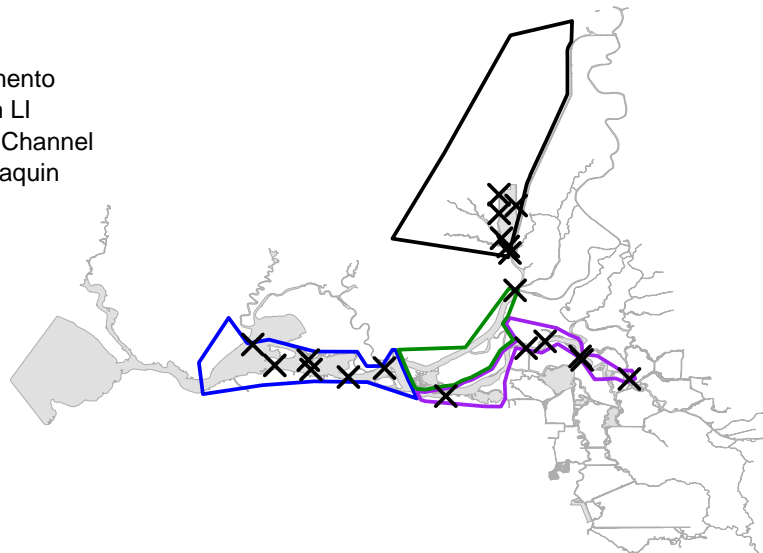
Week 8 (August 17 – 19, 2020)

Delta Smelt Total Catch by Site

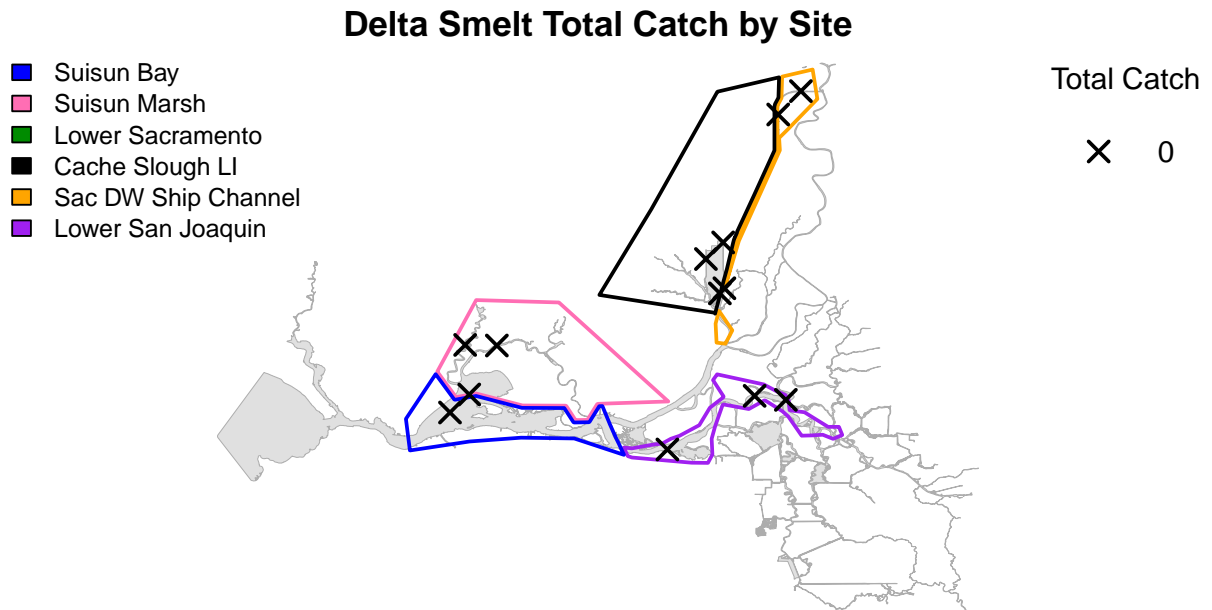
- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

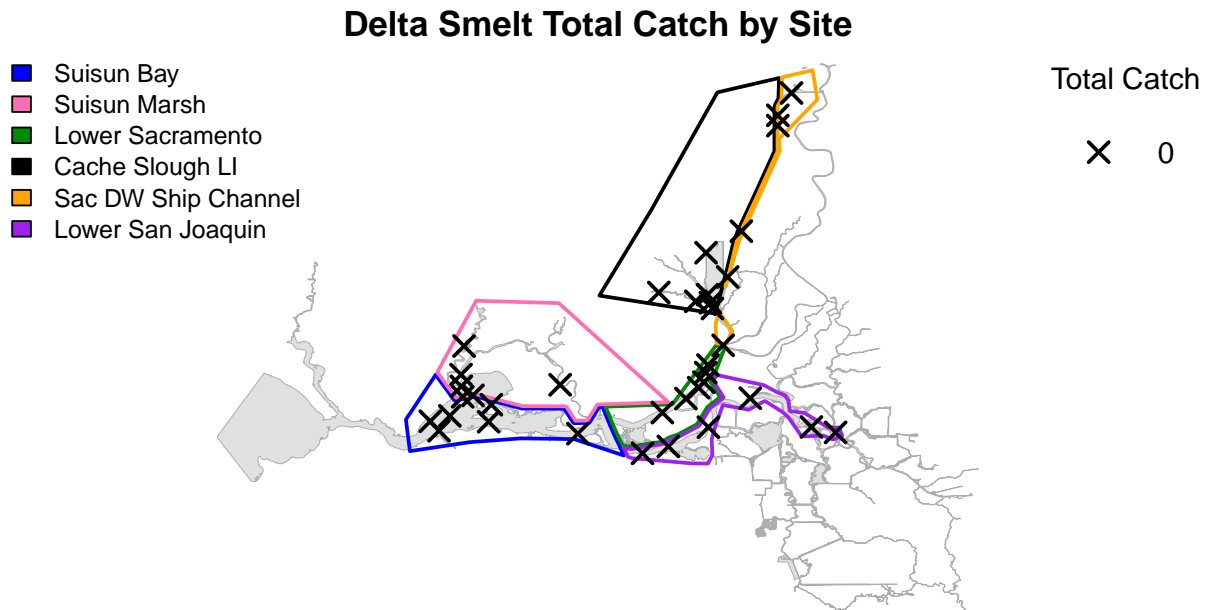
× 0



Week 9 (August 27 – 28, 2020)



Week 10 (August 31 – September 3, 2020)



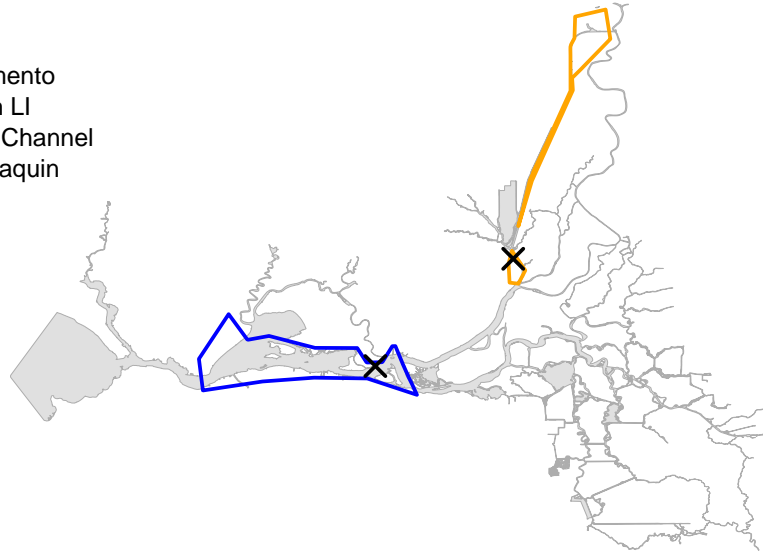
Week 11 (September 8 – 10, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

X 0



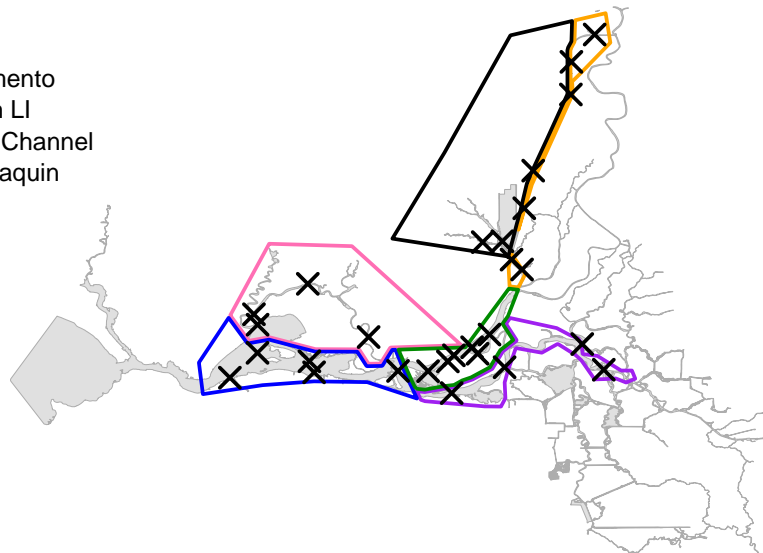
Week 12 (September 14 – 18, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

X 0



Week 13 (September 21 – 24, 2020)

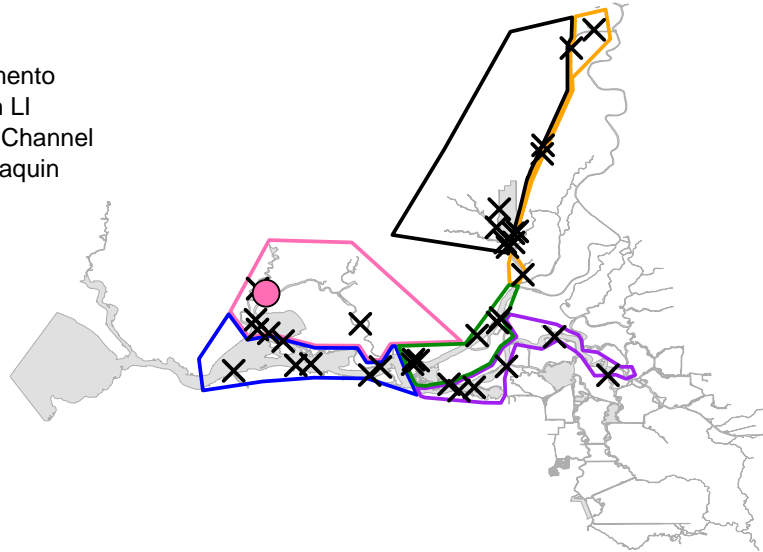
Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

× 0

● 1



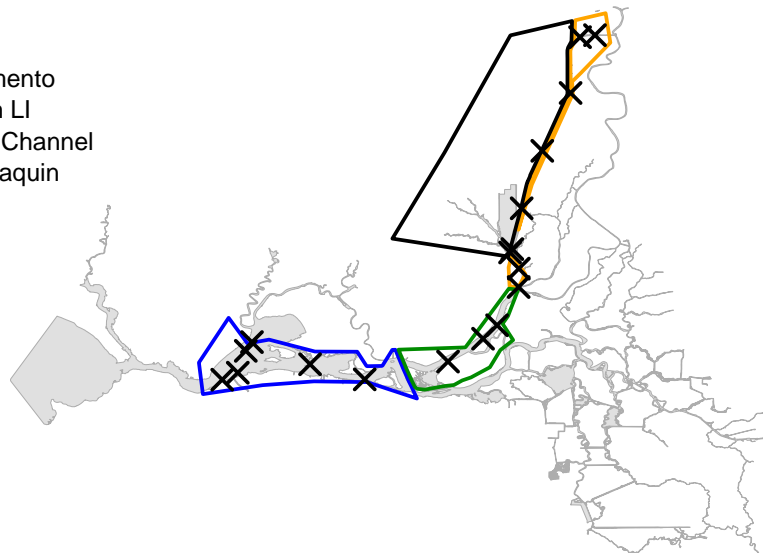
Week 14 (September 28 – 30, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

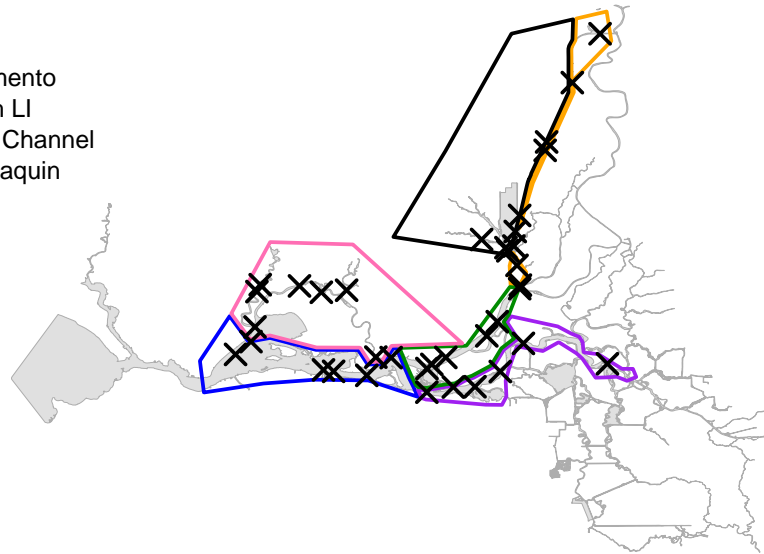
Total Catch

× 0



Week 15 (October 5 – 8, 2020)**Delta Smelt Total Catch by Site**

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

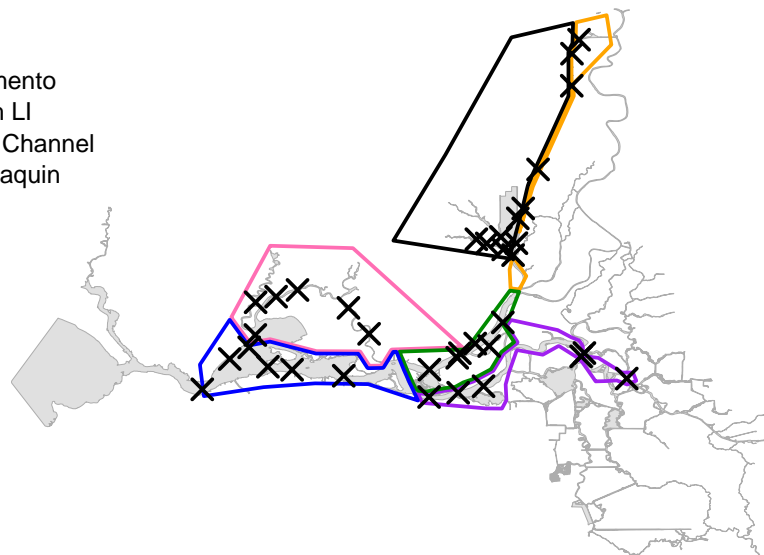


Total Catch

X 0

Week 16 (October 13 – 16, 2020)**Delta Smelt Total Catch by Site**

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



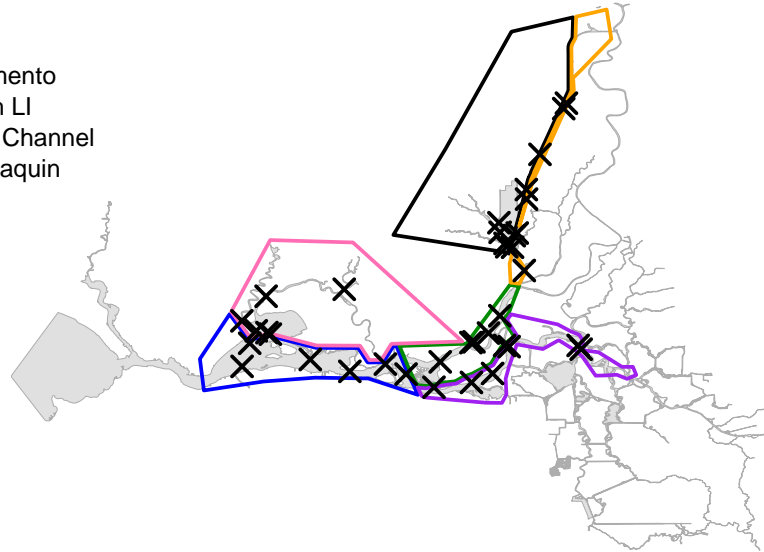
Total Catch

X 0

Week 17 (October 19 – 22, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



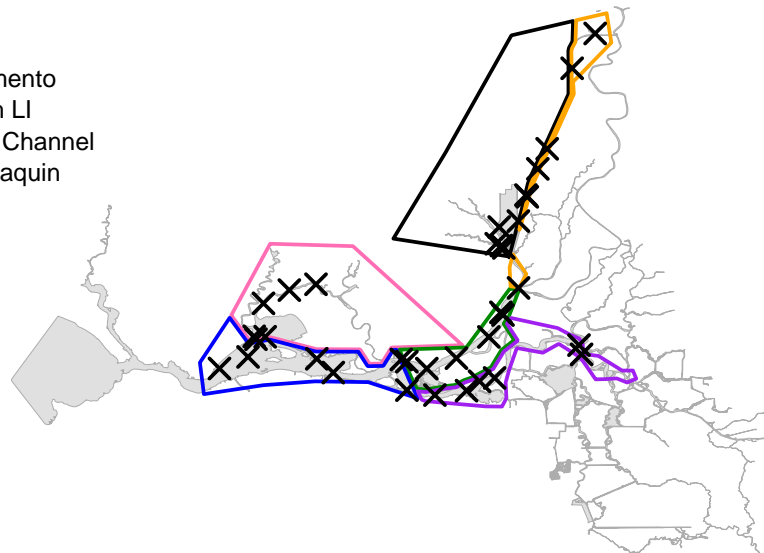
Total Catch

X 0

Week 18 (October 27 – 30, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



Total Catch

X 0

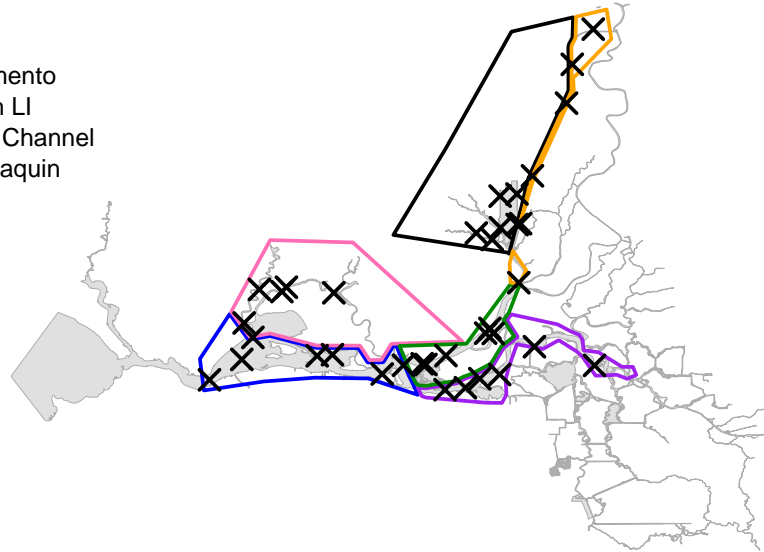
Week 19 (November 2 – 6, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

× 0



Week 20 (November 9 – 13, 2020)

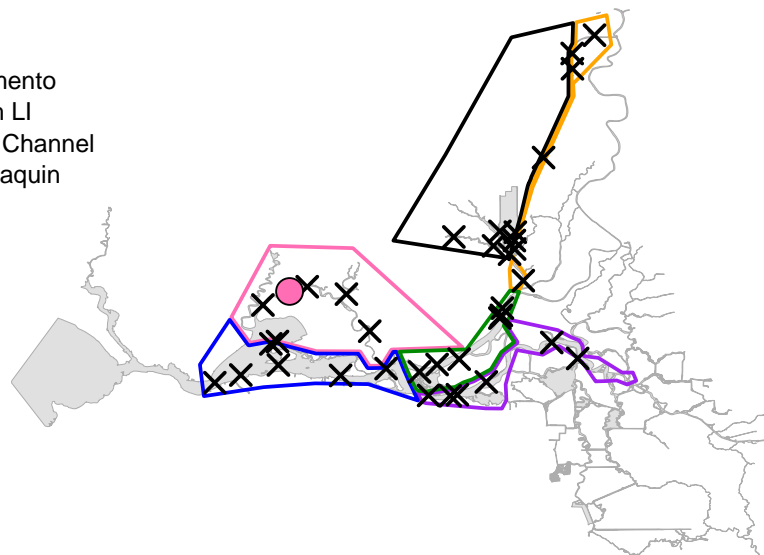
Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin

Total Catch

× 0

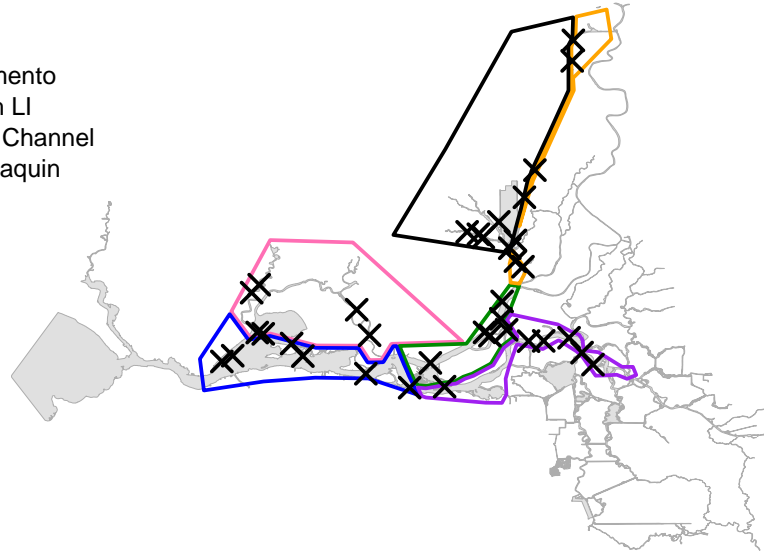
● 1



Week 21 (November 16 – 19, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



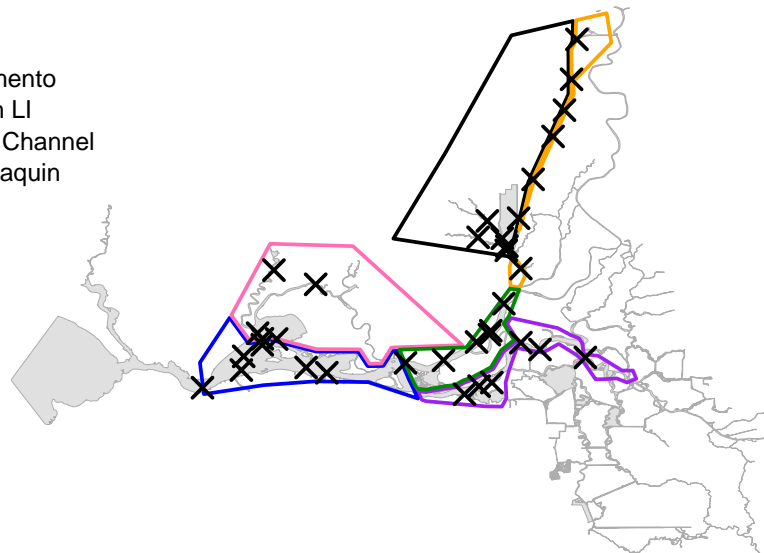
Total Catch

X 0

Week 22 (November 23 – 27, 2020)

Delta Smelt Total Catch by Site

- Suisun Bay
- Suisun Marsh
- Lower Sacramento
- Cache Slough LI
- Sac DW Ship Channel
- Lower San Joaquin



Total Catch

X 0

All Sampling Locations To Date

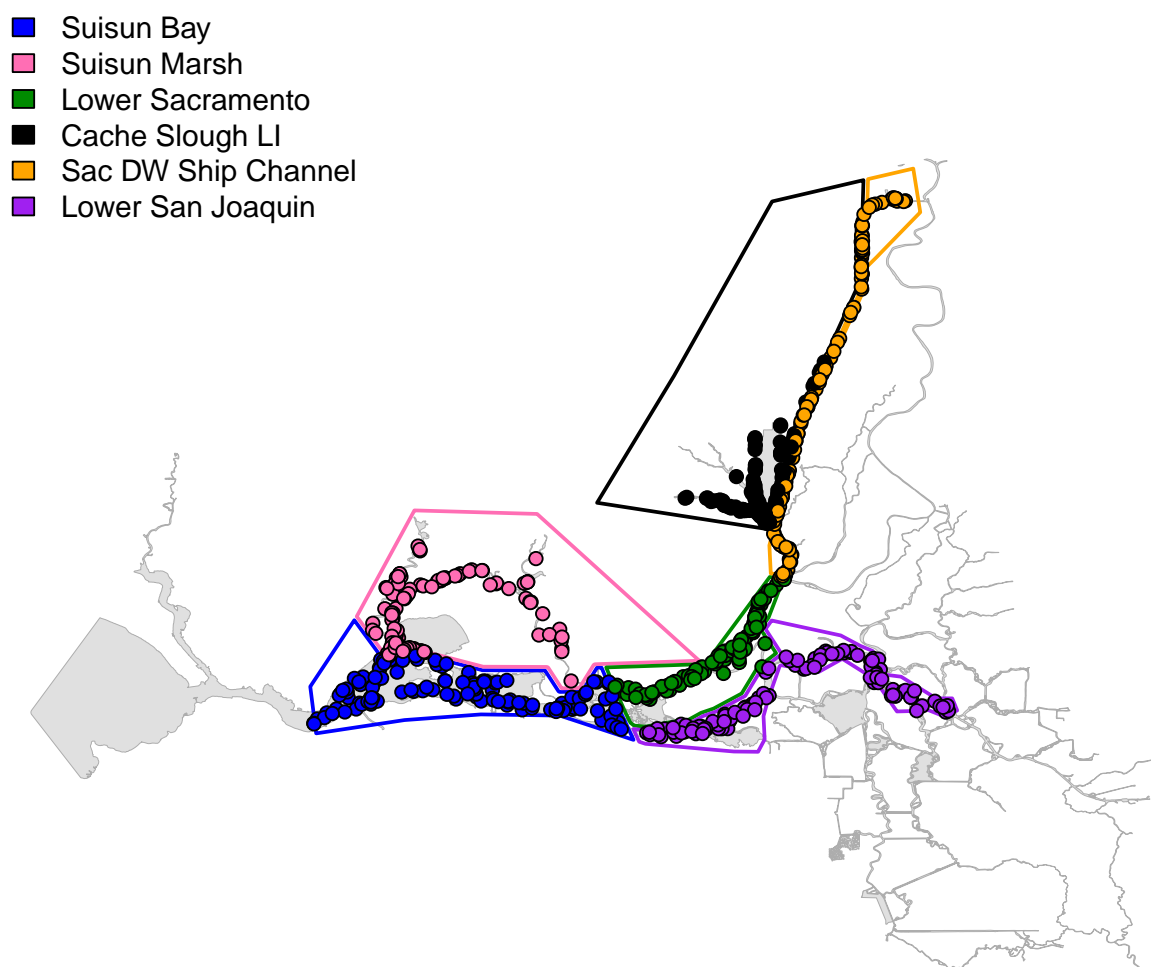


Table 2: Estimates of water volume (cubic meters) between 0.5-m and 4.5-m depth, by stratum.

Stratum	Volume
Cache Slough LI	33,420,492
Lower Sacramento	88,162,170
Lower San Joaquin	122,096,565
Sac DW Ship Channel	30,411,491
Suisun Bay	285,840,678
Suisun Marsh	76,278,718

References

D. L. Stevens and A. R. Olsen. Spatially balanced sampling of natural resources. *Journal of the American Statistical Association*, 99(465):262 – 278, 2004.